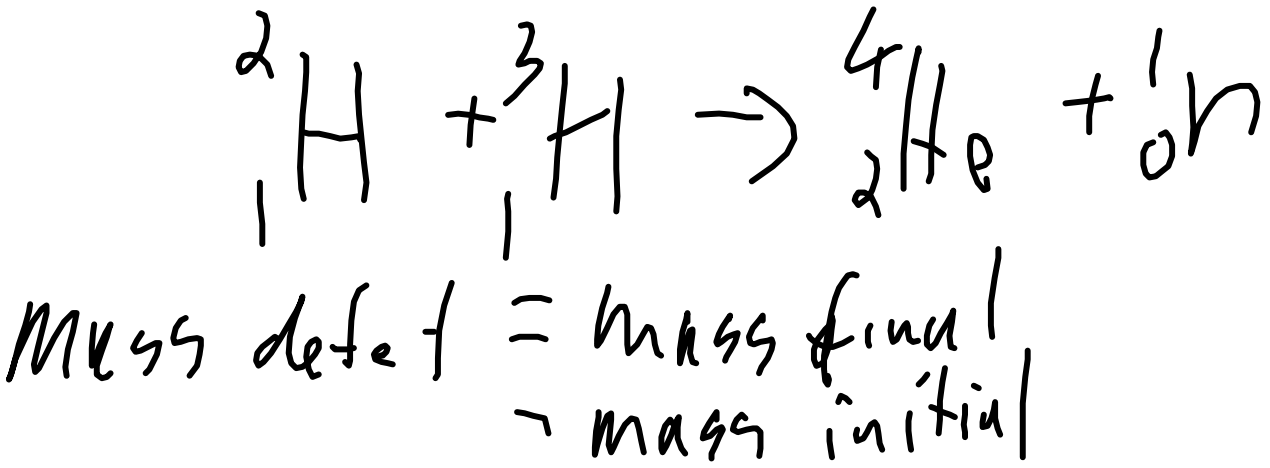
p652
Q9 and 10

Q9,10 - helium m=4.002603u
deuterium m = 2.0140u
tritium m= 3.0160492u n=1.008665u



4.002603+1.008665=5.011268
2.0140+3.0160492=5.0300492
5.011268-5.0300492=-0.0187812 u
the negative means some mass was lost as energy
E = 0.0187812x931.49=17.4945
17.4945 MeV given off in the reaction

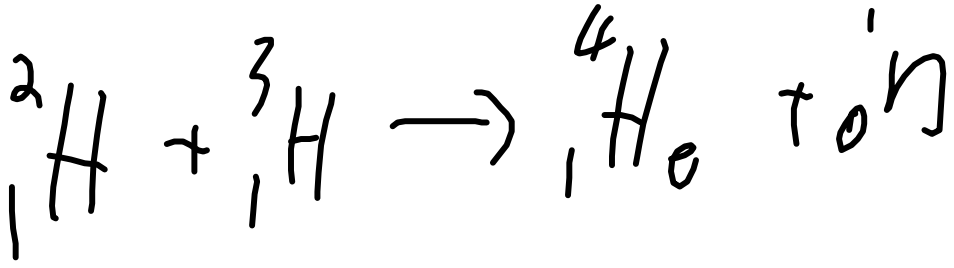
931.49 = energy per u lost

Q23

a) 1.00kgx6.02E23 atoms/0.235kg=
   2.562×10^{24} atoms
b) 200MeV/atom x 2.563×10^{24} atoms
   $2.563 \times 2 = 5.126 \times 10^{24}$MeV
c) 5.126E24x(1.602E-13)=8.2118E11 J/kg
   3600000000J/s/8.2118E11J/kg=0.0044
   0.0044 kg/s
d) 0.0044x365.25=1.6071 kg/year

p652 Q9,10 - helium m=4.002603u
deuterium m = 2.0140u
tritium m= 3.0160492u n=1.008665u
p654 Q 2, 5, 15, 21, 23
p263 Q 9, 14, 20, 22

Q9



mass of deuterium and tritium =

2.0140+3.0160492= 5.0300492u
mass of helium and a neutron
4.002603+1.008665=5.011268
mass final - mass initial
5.011268-5.0300492=-0.0187812
mass defect = 0.0187812u
where does the mass go? energy
if m is in kg, $E=mc^2$
if m is in u, x 931.49 MeV/u
0.0187812x931.49=17.4945 MeV
energy released
p655 Q23
mol = $6.02x10^{23}$ atom

a) molar mass = $6.02x10^{23}$ atoms/mas
uranium $6.02x10^{23}$ atoms/0.235kg
1kg x 6.02E23/0.235kg=2.562E24
$2.562x10^{24}$ atoms/kg

b) 200MeV/atom x $2.562x10^{24}$ atoms/kg
200x2.56=512
$5.12x10^{26}$MeV/kg

c) 3600MW = 3600 000 000J/s
1MeV = $1.602x10^{-13}$J
$5.12x10^{26}$MeV/kg x$1.602x10^{-13}$J/MeV
5.12x1.602=8.2022 x10^{13} J/kg

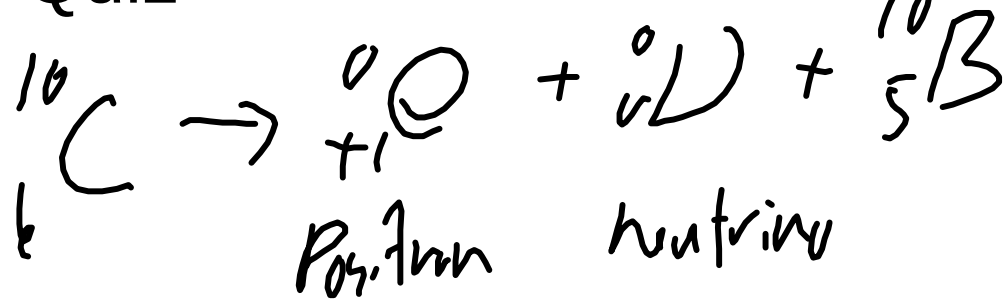
3600000000/8.2022=4.3891E8

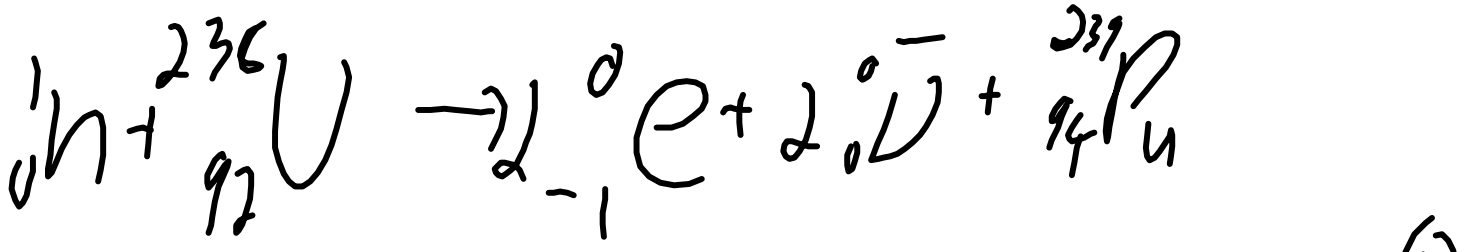
4.3891x10^{-5}kg/s

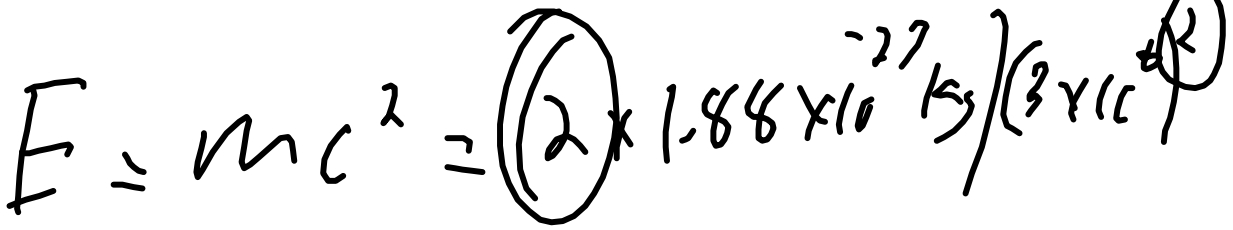
d) 4.389E-5x3600x24x365.25=1385.0631

1.4 tonnes/year

Group Quiz







bonus on nuke quiz

$N/N_o = 1/333 = e^{-0.693/1.1 \times t}$

ln(1/333) = -5.808142489980444

= -0.693/1.1 x t

ln is natural log - opposite exponent

$\ln(e^x) = x$ so $\ln(e^{-0.693/1.1 \times t})$

= -0.693/1.1 x t

t

=-5.808142489980444/(-0.693/1.1)=

9.219273793619752 = 9.2 minutes

p263 Q20
750kg car moving at 23m/s
car brakes = 15 kg iron
ΔT of the brakes
$E_k = Q$
0.5x750x23^2=198,375 J = mcΔT
ΔT = 198,375 J/(15kgx450J/kgºC)

198,375/(15x450)=29.3889
29ºC increase in temperature

p263
Q25
air compress 45N 0.25m 2.0J of heat leave

$W_{in} = Fxd = \Delta Energy$
45x0.25=11.25 J but you lose 2J so 11.25-2=9.25 J increase in thermal energy

p652 Q9,10 - helium m=4.002603u
deuterium m = 2.0140u
tritium m= 3.0160492u n=1.008665u
p654 Q 2, 5, 15, 21, 23
p263 Q 9, 14, 20, 22

p652 Q 9
deuterium and tritium combine in fusion to form helium and a neutron

mass defect for the reaction = mass of the reactants-mass of the products
2.0140+3.0160492=5.0300492 mass of deuterium and tritium
4.002603+1.008665=5.011268
5.0300492-5.011268=0.0187812
mass defect is 0.0187812u
where did this mass go?
changed into energy
$E= mc^2$ if m is in kg

E = mx 931.49MeV/u if m is in u

0.0187812x931.49=17.4945 MeV per reaction
p655 Q23
mol = 6.02×10^{23}
molar mass, is the mass of 1 mole of atoms/molecules
uranium 6.02×10^{23}molecules in 0.235kg of matter

a) 1.00kg will have 6.02/0.235= 25.617
2.5617×10^{24} atoms

b) 200 MeV / atom
$200 \times 2.5617 = 512.34 \times 10^{24}$ MeV
1.602×10^{-13} J = MeV

512.34x1.602=820.7687
8.207687×10^{13}J/kg of uranium

c) 3600 MW requires how much uranium?

3600000000J/s
/8.207687x10^{13}J/kg
= 3.6/8.207687=0.438613
4.38613x10^{-5}kg/s

d)

4.38613x10^{-5}kg/sx3600s/hx24h/dx365.25d/year

4.38613E-5x3600x24x365.25= 1384.15736 kg/year

1.4 tonnes of uranium/year

Test review

Ch12

thermal energy

temperature - kelvin, ºC

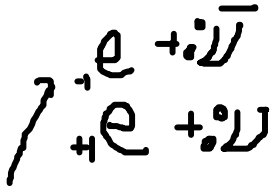
heat

Q=mcΔT change in temperature

Q=mH - change in state

thermal equilibrium = same temperature

Ch30



alpha, beta, gamma decay

isotopes
half-life

Ch31
Binding energy
mass defect x 931.49MeV/u
fusion/fission energy
parts of a reactor

p263

Q14
300W heat up
300g glass
250 g water
t=?
ti = 15ºC
tf = 100ºC

P=energy/time
energy = $mc\Delta T + mc\Delta T$
glass water
= 0.300kg x 664J/kgºC (100ºC-15ºC)
+ 0.250kg x4180J/kgºC(100ºC-15ºC)

= (0.3x664x85)+(0.25x4180x85)= 105757 J

P=Q/t so t= Q/P = 105757/300= 352.5233 s

352.5233/60=5.8754

5.9minutes